Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1. (Currently Amended) A method for increasing the roll offset operating range for a spacecraft using an earth sensor operating in either a dual scan mode or operating in a single scan mode which has at least two earth sensor scans, comprising the steps of:

moving the spacecraft to a first roll position, the first roll position having a roll angle that will cause the earth sensor to have a desired standard chord;

switching the earth sensor to a single scan mode by deselecting one of the earth sensor scans, which locks the earth sensor standard chord at or near the desired standard chord;

moving the spacecraft to a second roll position, which is a desired roll offset operating position for the spacecraft; and

using an [[the]] earth sensor roll output to calculate spacecraft roll at the roll offset operating position.

2. (Original) The method as recited in claim 1, wherein when operating in single scan mode, the earth sensor comprises an active scan and an inactive scan, and wherein the step of moving the spacecraft to a first roll position, comprises moving the spacecraft to a roll position so that the earth sensor standard chord is equal to or about equal to the chord width for the active scan at the desired roll offset operating position.

3. (Original) The method as recited in claim 1, wherein the earth sensor comprises a north scan and a south scan, and wherein the step of switching the earth sensor to single scan mode comprises deselecting the south scan for a positive roll offset operation and deselecting the north scan for a negative roll offset operation.

4. (Original) The method as recited in claim 1, wherein prior to the step of moving the spacecraft to the second roll position, the method comprises computing an estimated standard chord value for the locked standard chord.

5. (Original) The method as recited in claim 4, wherein the step of computing an estimated standard chord value comprises computing an estimated standard chord value $\hat{N}_0$ using the equation:

$$\hat{N}_0 = \cos^{-1}\left[\frac{\cos(\theta_e)+\sin(\theta_{cant})\sin(2\hat{\phi})}{\cos(\theta_{cant})\cos(\hat{\phi})}\right] + \cos^{-1}\left[\frac{\cos(\theta_e)-\sin(\theta_{cant})\sin(2\hat{\phi})}{\cos(\theta_{cant})\cos(\hat{\phi})}\right].$$

6. (Original) The method recited in claim 1, wherein the step of using the earth sensor to calculate spacecraft roll at the roll offset operating position comprises calculating spacecraft roll using the polynomial equation:

$$\phi = a_0 + a_1\hat{\theta}_s + a_2\hat{\theta}_s^2 + \cdots + a_N\hat{\theta}_s^N .$$

7. (Original) The method as recited in claim 6, wherein the coefficients $a_0, a_1, \cdots, a_N$ are computed by fitting an N^{th} degree polynomial to numerical values of the true earth sensor roll angle for a range of single scan chord widths.

8. (Original) The method as recited in claim 6, wherein $\hat{\theta}_s$ is determined by the equation:

$\hat{\theta}_s = \phi_{ESA} + \hat{N}_0 + N_{bias}$, where N_{bias} is a standard chord bias computed to correct for uncertainty in the value of the earth sensor's internal standard chord.

9. (Original) The method as recited in claim 1, wherein the step of using the earth sensor roll output to calculate spacecraft roll at the roll offset operating position further comprises correcting the roll angle for seasonal radiance biases and thermal distortions.

10. (Currently Amended) An attitude processing control system adapted to allow a spacecraft to perform missions which require spacecraft roll outside the normal roll operating range of a spacecraft earth sensor, the attitude processing and control system comprising:

an earth sensor which operates in either a dual scan mode or a single scan mode having at least two earth sensor scans;

control torquers; and

at least one processing unit adapted to receive attitude information from the earth sensor, compute attitude, and compute attitude control commands which direct the control torquers to move the spacecraft to maintain a desired attitude;

the attitude processing and control system being adapted to:

move the spacecraft to a first roll position, the first roll position having a roll angle that will cause the earth sensor to have a desired standard chord;

switch the earth sensor to single scan mode by deselecting one of the earth sensor scans, which locks the earth sensor standard chord at or near the desired standard chord;

move the spacecraft to a second roll position, which is a desired roll offset operating position for the spacecraft; and

calculate spacecraft roll at the roll offset operating position using an [[the]] earth sensor roll output.

11. (Original) The system as recited in claim 10, wherein the attitude processing and control system is further adapted to control the attitude of the spacecraft using the calculated spacecraft roll at the roll offset operating position.

12. (Original) The system as recited in claim 10, wherein the spacecraft control torquers comprise reaction wheels and thrusters.

13. (Original) The system as recited in claim 10, wherein the attitude processing and control system further comprises one or more attitude sensors selected from the group consisting of a sun sensor, a star tracker, and an inertial measurement unit.

14. (Original) The system as recited in claim 10, wherein when operating in single scan mode, the earth sensor comprises an active scan and an inactive scan, and wherein the attitude processing and control system moves the spacecraft to a first roll position having a roll angle such that the earth sensor standard chord is equal to or about equal to the chord width for the active scan at the desired roll offset operating position.

15. (Original) The system as recited in claim 10, wherein the earth sensor comprises a north scan and a south scan, and wherein the attitude processing and control system switches the earth sensor to single scan mode by deselecting the south scan for a positive roll offset operation and deselecting the north scan for a negative roll offset operation.

16. (Original) The system as recited in claim 10, wherein prior to moving the spacecraft to the second roll position, the attitude processing and control system computes an estimated standard chord value for the locked standard chord.

17. (Original) The system as recited in claim 16, wherein the attitude processing and control system computes the estimated standard chord value $\hat{N}_0$ using the equation:

$$\hat{N}_0 = \cos^{-1}\left[\frac{\cos(\theta_e)+\sin(\theta_{cant})\sin(2\hat{\phi})}{\cos(\theta_{cant})\cos(\hat{\phi})}\right] + \cos^{-1}\left[\frac{\cos(\theta_e)-\sin(\theta_{cant})\sin(2\hat{\phi})}{\cos(\theta_{cant})\cos(\hat{\phi})}\right].$$

18. (Original) The system as recited in claim 10, wherein the attitude processing and control system calculates spacecraft roll offset operating position using the polynomial equation:

$$\phi = a_0 + a_1\hat{\theta}_s + a_2\hat{\theta}_s^2 + \cdots + a_N\hat{\theta}_s^N .$$

19. (Original) The system as recited in claim 18, wherein the coefficients $a_0, a_1, \cdots, a_N$ are computed by fitting an Nth degree polynomial to numerical values of the true earth sensor roll angle for a range of single scan chord widths.

20. (Original) The system as recited in claim 18, wherein $\hat{\theta}_s$ is determined by the equation:

$\hat{\theta}_s = \phi_{ESA} + \hat{N}_0 + N_{bias}$, where N_{bias} is a standard chord bias computed to correct for uncertainty in the value of the earth sensor's internal standard chord.

21. (Original) The system as recited in claim 10, wherein the attitude processing and control system is further adapted to correct the roll angle for seasonal radiance biases and thermal distortions.

22. (Currently Amended) A spacecraft adapted to perform missions which require spacecraft roll outside the normal roll operating range of a spacecraft earth sensor, the spacecraft comprising:

an attitude processing and control system comprising:

an earth sensor which can operate in either a dual scan mode or a single scan mode having at least two earth sensor scans;

control torquers; and

at least one processing unit adapted to receive attitude information from the earth sensor, compute attitude and compute attitude control commands which direct the control torquers to move the spacecraft to maintain a desired attitude;

the attitude processing and control system being adapted to:

move the spacecraft to a first roll position, the first roll position having a roll angle that will cause the earth sensor to have a desired standard chord;

switch the earth sensor to single scan mode by deselecting one of the earth sensor scans, which locks the earth sensor standard chord at or near the desired standard chord;

move the spacecraft to a second roll position, which is a desired roll offset operating position for the spacecraft; and

calculate spacecraft roll at the roll offset operating position using an [[the]] earth sensor roll output.

23. (Original) The spacecraft as recited in claim 22, wherein the attitude processing and control system is further adapted to control the attitude of the spacecraft using the calculated spacecraft roll at the roll offset operating position.

24. (Original) The spacecraft as recited in claim 22, wherein the spacecraft control torquers comprise reaction wheels and thrusters.

25. (Original) The spacecraft as recited in claim 22, wherein the attitude processing and control system further comprises one or more attitude sensors selected from the group consisting of a sun sensor, a star tracker, and an inertial measurement unit.

26. (Original) The spacecraft as recited in claim 22, wherein when operating in a single scan mode, the earth sensor comprises an active scan and an inactive scan, and wherein the attitude processing and control system moves the spacecraft to a first roll position having a roll angle such that the earth sensor standard chord is equal to or about equal to the chord width for the active scan at the desired roll offset operating position.

27. (Original) The spacecraft as recited in claim 22, wherein the earth sensor comprises a north scan and a south scan, and wherein the attitude processing and control system switches the earth sensor to single scan mode by deselecting the south scan for a positive roll offset operation and deselecting the north scan for a negative roll offset operation.

28. (Original) The spacecraft as recited in claim 22, wherein prior to moving the spacecraft to the second roll position, the attitude processing and control system computes an estimated standard chord value for the locked standard chord.

29. (Original) The spacecraft as recited in claim 28, wherein the attitude processing and control system computes the estimated standard chord value $\hat{N}_0$ using the equation:

$$\hat{N}_0 = \cos^{-1}\left[\frac{\cos(\theta_e)+\sin(\theta_{cant})\sin(2\hat{\phi})}{\cos(\theta_{cant})\cos(\hat{\phi})}\right] + \cos^{-1}\left[\frac{\cos(\theta_e)-\sin(\theta_{cant})\sin(2\hat{\phi})}{\cos(\theta_{cant})\cos(\hat{\phi})}\right].$$

30. (Original) The spacecraft as recited in claim 22, wherein the attitude processing and control system calculates spacecraft roll at the roll offset operating position using the polynomial equation:

$$\phi = a_0 + a_1\hat{\theta}_s + a_2\hat{\theta}_s^2 + \cdots + a_N\hat{\theta}_s^N .$$

31. (Original) The spacecraft as recited in claim 30, wherein the coefficients $a_0, a_1, \cdots, a_N$ are computed by fitting an N^th degree polynomial to numerical values of the true earth sensor roll angle for a range of single scan chord widths.

32. (Original) The spacecraft as recited in claim 30, wherein $\hat{\theta}_s$ is determined by the equation:

$\hat{\theta}_s = \phi_{ESA} + \hat{N}_0 + N_{bias}$, where N_{bias} is a standard chord bias computed to correct for uncertainty in the value of the earth sensor's internal standard chord.

33. (Original) The spacecraft as recited in claim 22, wherein the attitude processing and control system is further adapted to correct the roll angle for seasonal radiance biases and thermal distortions.